

Ceramic Matrix Composite Environmental Barrier Coating Durability Model, Phase I

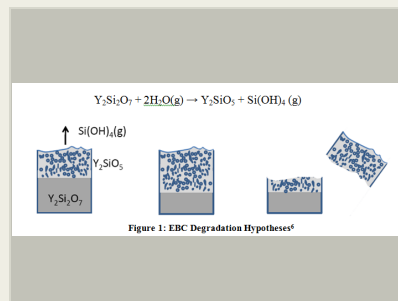
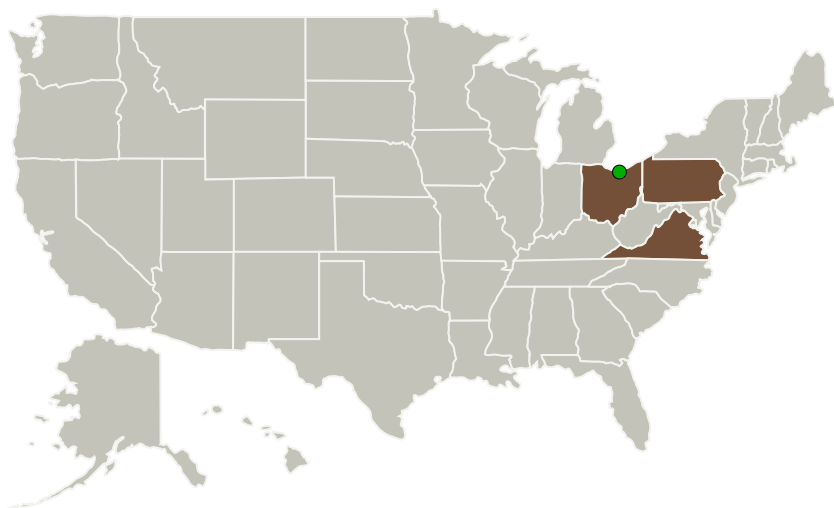
Completed Technology Project (2015 - 2016)



Project Introduction

As the power density of advanced engines increases, the need for new materials that are capable of higher operating temperatures, such as ceramic matrix composites (CMCs), is critical for turbine hot-section static and rotating components. Such advanced materials have demonstrated the promise to significantly increase the engine temperature capability relative to conventional super alloy metallic blades. They also show the potential to enable longer life, reduced emissions, growth margin, reduced weight and increased performance relative to super alloy blade materials. MR&D is proposing to perform a combined analytical and experimental program to develop a durability model for CMC Environmental Barrier Coatings (EBC). EBCs are required for CMCs in turbine exhaust environments because of the presence of high temperature water. The EBC protects the CMC and significantly slows recession. However, the durability of these materials is not well understood making life prediction very challenging. This program will be the first step in developing a tool to accurately evaluate the life of the EBC for a CMC turbine blade helping to facilitate their inclusion in future engine designs. This will be done by developing a custom, user defined element formulation for finite element modeling to simulate the kinetic reactions of the EBC with the turbine exhaust. It will be built on the back of earlier work developing such an element to model the oxidation of carbon fiber in reentry environments.

Primary U.S. Work Locations and Key Partners



Ceramic Matrix Composite
Environmental Barrier Coating
Durability Model, Phase I
Briefing Chart Image

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Organizations Performing Work	Role	Type	Location
Materials Research and Design, Inc.	Lead Organization	Industry	Wayne, Pennsylvania
● Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio
University of Virginia-Main Campus	Supporting Organization	Academia	Charlottesville, Virginia

Primary U.S. Work Locations

Ohio	Pennsylvania
Virginia	

Project Transitions

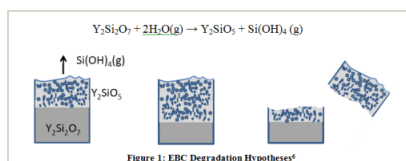
▶ **June 2015:** Project Start

✓ **June 2016:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/138736>)

Images



Briefing Chart Image

Ceramic Matrix Composite
Environmental Barrier Coating
Durability Model, Phase I Briefing
Chart Image
(<https://techport.nasa.gov/image/132632>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Materials Research and Design, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

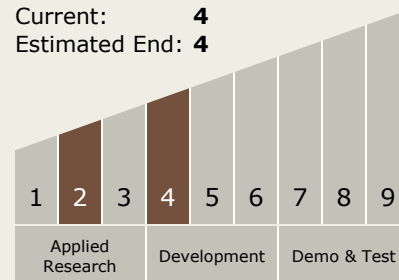
Michael Dion

Technology Maturity (TRL)

Start: 2

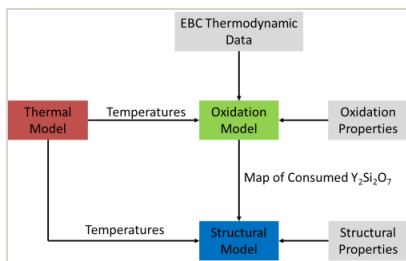
Current: 4

Estimated End: 4



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Final Summary Chart Image

Ceramic Matrix Composite
Environmental Barrier Coating
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Image

(<https://techport.nasa.gov/image/128414>)

Technology Areas

Primary:

- TX11 Software, Modeling, Simulation, and Information Processing
 - └ TX11.2 Modeling
 - └ TX11.2.1 Software Modeling and Model Checking

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System